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IN REPLY, PLEASE REFER TO
EPR/CO/HSER

17 June 1990

Mr. Harry Kim, Chairman
Hawaii Local Emergency Planning Committee
34-A Rainbow Drive
Hilo, Hawaii 96720

Subject: Review of the Revised Puna Geothermal Venture 25 Power Project Emergency Response Plan-Version No. 3

Dear Mr. Kim:

Thank you for the opportunity to review the Revised Puna Geothermal Venture (PGV) 25 MW Power Project Emergency Response Plan-Version No. 3. The plan now includes a reasonable review of the potential hazards that may be posed by the project. Comments and recommendations provided by the Department of Health to PGV to improve and enhance the document have been addressed by PGV. If the revised plan is fully implemented on a continuing basis while the facility is constructed and operated, public and private interests should be prepared for the emergencies that may arise from the PGV facility. The plan also provides an excellent reference for state and county agencies to use for emergency planning purposes as they relate to the PGV facility.

We look forward to your continued cooperation to improve Hawaii's capability to respond to chemical emergencies. If you have any questions regarding this review, please contact Bruce Anderson, Ph.D. at 548-4139.

Sincerely,

JOHN C. LEWIN, M.D., Chairman,
Hawaii State Emergency Response
Commission and Director of Health

Attachment 4
to
Element II Report

PUNA GEOTHERMAL VENTURE

REVIEW AND RESPONSE TO THE ELEMENT III, PART I REPORT

INDEPENDENT AIR AND NOISE PROGRAM REVIEW CONCERNING THE JUNE 1991 UNCONTROLLED VENTING OF THE PUNA GEOTHERMAL VENTURES KS-8 GEOTHERMAL WELL

PUNA GEOTHERMAL VENTURE
REVIEW AND RESPONSE TO THE
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INDEPENDENT AIR AND NOISE PROGRAM REVIEW
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PUNA GEOTHERMAL VENTURES KS-8 GEOTHERMAL WELL

PGV Response to the Element III-I Executive Summary.

Puna Geothermal Venture (PGV) believes that the extensive information provided in the Element III-I Report can be categorized into two areas. First, the Report contains a review of the air and noise monitoring programs in the Puna area and a "precursory appraisal" of the issued permits regarding air and noise. Both of these have only a peripheral applicability to the KS-8 well uncontrolled flow event. Second, the Report discusses the KS-8 well uncontrolled flow event emission scenario and suggess how to anticipate, mitigate and manage any possible similar future events. Both of these topics bear more directly on the KS-8 well uncontrolled flow event.

PGV believes that the Element III-I Report is misleading when it states that "ambient measurements of noise and H2S indicated levels markedly above those anticipated in the issued permits as limits or believed to be acceptable," because the uncontrolled flow event was obviously not a "permitted" emission, but one covered by the emergency event conditions of the permits and the PGV Emergency Response Plan (ERP). In addition, PGV agrees that unifying, or at least coordinating, the air monitoring efforts would enhance the regional coverage and the consistency of the collected data.

No noise or hydrogen sulfide mitigation systems were installed on the "choke" line because discharge of geothermal steam or fluid through the horizontal choke line was not a permitted action, nor was it ever considered as an emergency event. PGV's noise abatement consultant was on-site during the uncontrolled flow event, and prepared a noise abatement plan. However, the plan was not immediately implemented because of safety considerations. See PGV Response AI for a discussion of lack of noise abatement during the uncontrolled flow event. See also Attachment 1 to the PGV Response to the Element I Report for additional information about the systems which have now been installed, and will be installed, to abate noise and hydrogen sulfide emissions if such an event were to occur again.

While emissions estimates may have helped the emergency response personnel during the uncontrolled flow event, as discussed in PGV Response AH, sampling of the KS-8 well was not possible during the uncontrolled flow event for safety reasons. PGV does not disagree with the desirability of characterizing the components of drift emissions. However, given the substantial differences between the operation of

geothermal projects which have continuous drift emissions (e.g., those projects operating in The Geysers) and the PGV project (with no normal emissions), PGV does not believe that the expense and effort required for ambient monitoring of components of the drift are justified (see PGV Responses M, AN and AQ).

PGV believes that the Element III-I Report summary review of the Hawaii Department of Health (DOH) air permits is, as the Element III-I Report itself indicates, only a "precursory" review, and one which PGV believes unfairly and superficially criticizes the DOH and the the extensive permit conditions which include many restrictive limitations on the allowable increases in ambient hydrogen sulfide concentrations (see PGV Responses A, M, S, AN, AP and AX). Further PGV does not believe that the uncontrolled flow event demonstrates that the County of Hawaii Geothermal Resource Permit noise limitations should or must be changed.

PGV notes that "Ormat Energy Systems International" and PGV should not be considered synonymous and cautions that these two terms should not be used interchangeably.

A. Page 5, Recommendation 2.1.1., regarding discontinuing background monitoring sites.

PGV has one background monitoring station located at the Woods Site. For further background, see PGV Response S. Hydrogen sulfide monitoring at the Woods Site was specifically instituted by PGV's air monitoring contractor, Science Applications International Company (SAIC), for two reasons: (1) since hydrogen sulfide levels were already being monitored at the site, concurrently running both the old and the new monitoring instruments at the same location for a year or so would provide information which could validate the earlier data; and (2) since the Authority to Construct permits (ATCs) issued for the Puna Geothermal Venture (PGV) project specifically required PGV to prevent its operations from causing the ambient air concentrations of hydrogen sulfide to exceed certain limits over the background levels of hydrogen sulfide, PGV would need to know the background levels to verify its compliance with the ATC conditions. While discontinuing hydrogen sulfide monitoring at the Woods Site may appear reasonable on its face considering the excellent historic record for the area, PGV believes that this is inappropriate because it would result in PGV's inability to document its compliance with the ATCs. See PGV Response S.

B. Pages 5 and 6, Recommendation 2.1.2., regarding unifying air monitoring efforts into single program managed by the state.

PGV agrees that unifying, or at least coordinating, the monitoring efforts would enhance the regional coverage and the consistency of the collected data. However, PGV notes that most of these recommendations have very little, if anything, to do with the uncontrolled flow event from the KS-8 well or its aftermath, and believes that the discussion and implementation of these recommendations, as suggested below, should be conducted separately from those discussions regarding the KS-8 well uncontrolled flow event. PGV and its air monitoring consultant will continue to work with representatives of the Hawaii State Department of Health (both the Clean Air Branch and Air Surveillance and Analysis Branch) to determine the specifics of the air monitoring system, including parameters to be monitored, modem access, technical specifications, and quality assurance/quality control procedures. Given the current status of each of the three monitoring systems, PGV believes that integration should be undertaken only after careful consideration of the ability of the reconfigured, integrated system to adequately meet the conditions placed on the PGV project. Recommendations regarding procurement and operation of field-portable hydrogen sulfide monitoring systems for use by agency personnel in emergency situations are discussed in PGV Response W to the Element II Report . As a point of information, PGV has already purchased a new Jerome monitor for backup use on site and for use by agency personnel.

C. Page 7, Recommendation 2.1.3., regarding initial suggestions regarding redeployment of the air monitoring stations.

PGV has no objection to "Map A" becoming the starting point for any discussion between PGV and DOH regarding redeployment of the existing monitoring stations.

D. Page 7, Recommendation 2.2.1., regarding the receipt and investigation of complaints.

See PGV Response L. In addition, GRP Condition 21 requires that the noise monitoring program also allow for the correlation of any complaints of noise from the public with the noise levels and the operations occurring on site.

E. Page 7, Recommendation 2.2.2., regarding use of a mobile/portable, unmanned noise monitor.

In concept, such a system might prove useful; however, the approved noise monitoring program is already focused on determining compliance with the GRP conditions. Since compliance is specifically required at the nearest residence, that is where the monitors are approved to be located (see PGV Response W).

F. Page 7, Recommendation 2.2.3., regarding agency spot checks and calibration of noise monitoring.

PGV would not object to the implementation of this recommendation.

G. Pages 7 and 8, Recommendation 2.2.4., regarding evaluation of effectiveness of current noise standards and expert opinion on BACT determinations.

Regarding noise BACT determinations, PGV has, for the past year, utilized the services of a recognized expert in noise control for geothermal power projects, Tom Norris, a principal in Consultants in Engineering Acoustics, to evaluate, design, and manage the fabrication/implementation of any and all noise abatement equipment/procedures necessary to comply with the current requirements of the GRP, including the implementation of BACT.

H. Page 8, Recommendation 2.2.5., regarding the intent of monitoring.

The approved and implemented noise monitoring and reporting program was specifically developed to document PGV's compliance with the GRP permit conditions, and to provide the type of data requested by the DOH. See PGV Response G regarding the work already done to reduce noise emissions.

I. Page 8, Recommendation 2.2.6., regarding specific noise identification.

See PGV Responses E and G.

J. Page 8, Recommendation 2.2.7., regarding noise control versus worker safety.

Actions taken by PGV to date to control noise have not compromised worker safety, and PGV will continue to hold worker safety as a paramount concern. Presumably, the Element III-I Report's concern is with the wrapping of the second drilling rig substructure in acoustic blankets to control engine noise, which also could trap steam and/or hydrogen sulfide in the substructure and pump work area. However, the rig substructure will only be so wrapped during the very early phase of the drilling, which has been determined to be the noisiest. The wrapping is to be removed once the large diameter surface casing is set, well before the depth at which the drilling would or could encounter any steam containing hydrogen sulfide. The engine and drive noise control is provided by an inner "cocoon" of steel acoustic panels, doubled blankets, custom and "critical grade" mufflers, sound absorbing materials, and 3/4"-thick plywood. These measures reduce engine compartment noise to about the same noise level of electric rig hoist and rotary table drives.

K. Page 8, Recommendation 2.3.1, regarding evaluation of DOH proposed ambient air quality standard and health complaints.

It is incorrect to imply that the "100 ppbv one hour average limitation" is an "AAQS" (ambient air quality standard), because the existing permit conditions do not use the 100 ppbv one hour average limit as an "allowable" ceiling for routine operations. Please see PGV Response W to the Element II Report and PGV Response AX.

L. Page 8, Recommendation 2.3.2., regarding consolidating investigation of noise and air quality complaints with one agency.

PGV believes that this recommendation is unnecessary and unrelated to the uncontrolled flow event from the KS-8 well and its aftermath. PGV is required to respond to complaints by the conditions of the GRP, ATC, and PGV Emergency Response Plan (ERP), and PGV has developed procedures to fulfill these requirements.

M. Page 8, Recommendation 2.3.3., regarding timely resource characterization.

PGV does not object to providing timely resource characterizations but would point out that such information would not facilitate better emissions estimates under routine, normal operations since the PGV project will operate as a closed system, and will not release any of the produced geothermal fluid, or its contaminants, into the air. This is in contrast to all of the facilities in The Geysers geothermal area, which discharge as much as 80 percent of the geothermal fluid into the environment.

N. Pages 8 and 9, Recommendation 2.3.4., regarding DOH participation in source testing during all types of flow events.

PGV does not want to presuppose that the DOH lacks the ability to independently measure hydrogen sulfide emissions resulting from PGV's geothermal operations. PGV has cooperated, and continues to cooperate, with DOH in developing the necessary sampling program. PGV accepts and supports those recommendations contained in points one and two, and proposes that these activities be conducted as a joint effort between DOH and PGV. Please see PGV Response AR regarding point three and PGV Response AJ regarding point four. See PGV Response J to the Element I Report for a discussion of the mechanics of the uncontrolled flow event. PGV believes that the PGV ERP adequately described the consequences of this uncontrolled flow event (see PGV Response I to the Element II Report). PGV further believes that any actions taken in response to the recommendations in the last point are part of its compliance responsibilities under the GRP and the PGV ERP.

O. Page 12, paragraph 5, and page 13, paragraph 2, discussion regarding security measures at the SAIC sites.

The author of the Element III-I Report may be unaware of the previous vandalism at the PGV SE site, which necessitated the described security measures.

P. Page 13, paragraphs 1 through 4, regarding coordination or integration of the DOH/PGV monitoring systems.

Please see PGV Response B.

Q. Page 14, paragraph 4, and page 15, paragraphs 1 and 2, regarding intake probes/manifolds and cleanliness at the PGV SE station.

The vertical design of the SAIC sampling probes has proven from experience to be less susceptible to accidental damage or vandalism than the inverted sampling "canes". The teflon rain cap serves the same purpose as a downward-pointing intake, in that the air flow must travel upward to reach the sample intake. The large diameter and blower motor combination greatly reduce the sample residence time without causing unwanted pressure drops in the intake manifold.

It is unlikely that the observed condition resulted in any substantial degradation of the sample at the SE monitoring site. The sample takes less than 10 seconds to reach the hydrogen sulfide detector, and the large diameter intake manifold further reduces sample contact with any deposited material. In addition, since the routine calibration gases are introduced through the same sample line filter as the ambient sample, any sample degradation from deposited material would be readily apparent. With the routine replacement of this filter, as has been the practice, no degradation has been observed at any of the three PGV monitoring sites operated by SAIC.

R. Page 16, paragraph 3, regarding SAIC quality assurance program.

This comment correctly notes that SAIC does not use a zero drift tolerance of 0.025 ppm. The SAIC quality assurance plan specifies a zero drift tolerance of ± 2 standard deviations of the mean zero drift which, for these analyzers, is approximately 0.005 ppm. This drift is well within the capability of the strip chart recorders' negative range of two divisions (0.010 ppm) below the zero line, and a much closer tolerance than the 0.025 ppm previously mentioned.

However, the recommended 10 percent zero offset would allow observation of any unexpected drift problems, and this will be implemented immediately.

S. Page 16, paragraphs 4 and 5, and page 17, paragraph 1,regarding suggestions for deletion of background hydrogen sulfide monitoring stations and existing background hydrogen sulfide levels.

PGV concurs that the monitoring record developed to date supports the statement that background levels of hydrogen sulfide are currently zero. However, PGV believes that it would be imprudent to simply remove all stations generally considered as measuring background levels without first considering the possibility for future sources in the vicinity of the PGV project, whether natural or anthropogenic, raising the current background level of hydrogen sulfide. As the Element III-I Report recognized in the above paragraphs, the ATC limits PGV's impact on the ambient concentration of hydrogen sulfide to specified amounts over background (depending on the operation). If another appreciable source of hydrogen sulfide is established in the area, the background level will likely rise above zero, and PGV's ability to demonstrate compliance with the ATC permit conditions as written will be compromised. DOH offered, and PGV accepted, very restrictive limitations on the allowable increases in ambient hydrogen sulfide concentrations only because these levels were to be measured above background, and it is not appropriate to assume that the background level will not change over the life of the PGV project.

T. Page 17, paragraph 2, regarding strip charts or hard data copies.

Modification of strip charts to record a dual range should be considered as a possible improvement to the overall air monitoring network. SAIC's span and zero drift tolerance and action requirements are clearly delineated in the Quality Assurance Plan and Standard Operating Procedures for the program.

U. Page 17, paragraph 3, regarding monitoring meteorology at additional stations.

PGV, in consultation with its air monitoring consultant, SAIC, believes that this is an issue which should be addressed, although there is a concern that this site would not be representative of the project area. PGV would be willing to work with the DOH in this regard.

V. Page 17, paragraphs 4 and 5, and page 18, paragraphs 1 through 3, discussion of capabilities of the noise monitoring equipment.

It should be noted that the Quest 2800 Sound Level Meter does develop the referenced L_{10} data, but a readout device, such as a serial printer, is required to access this data. Further, the hand-held meters are usually used to check for steady drilling noises, which are then compared to the GRP noise limits.

Although it is conceivable that rain could cause interfering noises when falling on the steel pipe monitor microphone housings, examination of the data from the fixed noise monitoring instruments suggests that the sounds of rain drops striking any nearby vegetation or structure appears to exceed the sound of rain on the housing. Thus, rain usually causes less noise at the southwest monitor than the other monitors, which have vegetation nearby. If it had been determined that the rain had caused significant noise at the quieter (southwest) site, experiments would have been run with alternative coverings. A dehumidifier for the microphones may help to make the monitors more reliable, although there have not been any failures.

W. Page 18, paragraph 4, and page 19, paragraphs 1 through 3, GRP noise requirements.

Condition 24a requires that PGV-generated noise not exceed a 12-hour daytime average of 55 dBA and a 12-hour nighttime average of 45 dBA at the nearest residence, subject to the waiver of these limitations as specified in Condition 24c. Condition 24b (using the word "shall") requires that PGV minimize impact noise, and provides guidance (using the word "should") to restrict short-term exceedences of these 12-hour noise limits to less than 10 percent of the time in any 20-minute period. These conditions, therefore, do not specify an L_{10} for a 20-minute reporting period, as stated in the Element III-I Report, but limit (specified) daytime and nighttime noise averages and place limits on the magnitude and duration of the short-term exceedences. PGV's noise monitoring contractor, SAIC, designed the noise monitoring program required under GRP Condition 21 to sample, record and report the monitored noise levels. It should also be pointed out that GRP Condition 21 requires that the noise monitoring program also allow the correlation of any complaints of noise from the public with the noise levels and the operations occurring on site. The noise monitoring program, in conformance with GRP Condition 21, was also submitted to, and approved by, the Hawaii County Planning Director, including monitoring at the selected sites instead of the nearest residences (since the monitoring sites are actually closer to the project than the nearest residence).

X. Page 20, paragraphs 1 and 3, regarding BACT.

PGV has, for the last year, retained the services of Tom Norris of Consultants in Engineering Acoustics, a recognized expert on the suppression of noise from geothermal operations, to assist PGV in the design and implementation of noise abatement strategies for the project. Much of his work has been specifically directed towards reducing those specific noises and sounds which are, or may become, irritants to the surrounding residents.

Y. Page 20, paragraph 2, regarding lack of silencers on the steam pipeline rupture disks.

At the time of the Element III-I Report author's inspection, there were no silencers on the steam pipeline rupture disks. This is because the steam pipelines, which were still under construction, were not yet ready to be placed into service, and the design noise abatement equipment was not yet installed. Equipment which may be installed includes acoustic pipe and valve wrapping, silencers on rupture disks, filling any hollow pipe stands, and backpressuring or silencing any valves subject to unusually high pressure drops.

Z. Page 20, paragraph 6, and page 21, paragraph 1, regarding an initial release of hydrogen sulfide.

As documented on pages 7 and 8 of the Element I Report, the circulation of "bottoms up" (drilled material settled on the bottom) discussed in the Element III-I Report was not the initial occurrence of a release of hydrogen sulfide; several such releases (which are permissible under the GRP and ATC) had occurred during the previous days. The concentration of hydrogen sulfide measured by the mudlogger during the specified event was neither as high as reported in the Element III-I Report, nor as high as was measured during the previous events. This discrepancy is believed to result from the Element III-I Report having relied on preliminary data, a fact recognized by the author when he stated on page 20, paragraph 5 that "The confidence in the (emission) scenario is thus lessened and may warrant correction."

AA. Page 21, paragraph 3, regarding initial release.

The first indication of the kick observed by the driller was not an increase in the observed weight on the drilling hook, but a significant decrease in the hook weight as the drilling mud in the hole was rapidly lifted when the bit encountered the overpressured geothermal resource. In addition, the 14 foot drop initially reported was later found to not have been correct, but to have been simply damage to the footage reel digital readout. Examination of the analog recording chart showed readings from the digital printout to be incorrect.

AB. Page 21, paragraph 4, and page 22, paragraph 1, discussion of geothermal flow rate and hydrogen sulfide emission rate until 06:00 on June 13, 1991.

Based upon subsequent calculations and estimations (see PGV Response AC), PGV believes that the estimate of 150,000 to 200,000 lbs/hr for the quantity of <u>steam</u> flow is high, although this estimate is reasonably accurate for the <u>total</u> quantity of geothermal <u>steam</u> <u>and</u> <u>fluid</u> emitted. The concentration of hydrogen sulfide in the

geothermal steam from KS-8 assumed by the Element III-I Report is also too high for two (2) reasons: (1) the average hydrogen sulfide concentration in the steam produced under atmospheric conditions during the flow test of KS-3 was approximately 650 ppmv, not the 700 to 900 ppmv assumed in the Element III-I Report; and (2) this concentration of 650 ppmv hydrogen sulfide in the geothermal steam calculates back to a hydrogen sulfide concentration in the produced geothermal steam and fluid of only 440 ppmv. By multiplying the estimated volume of geothermal steam and fluid produced by KS-8 (150,000 to 200,000 lbs/hr) by the average calculated hydrogen sulfide concentration in the geothermal steam and fluid produced from KS-3 (440 ppmv), PGV estimates that from 66 to 88 lbs/hr of hydrogen sulfide were emitted from KS-8 during this period of the uncontrolled flow, not the 180 lbs/hr reported in the Element III-I Report.

AC. Page 22, paragraph 2, discussion of geothermal flow characteristics and hydrogen sulfide emission rate from 06:00 on June 13, 1991 to start of water injection at approximately 09:30 on June 13, 1991.

PGV has continued to extensively analyze the available information regarding this period of the uncontrolled flow event. Based upon bottom hole temperatures and pressures measured on June 21, 1991, subsequent to the venting from KS-8; surface pressures measured while pumping water into the drill pipe; reasonable assumptions regarding the enthalpy of the geothermal resource; and reasonable assumptions of geothermal resource losses at the bottom of the casing shoe, PGV estimates that a total of approximately 246,000 lbs/hr of geothermal fluid was released while the choke was open and no water was being injected down the drill pipe (see PGV Response AD). This release is reasonably assumed to have partitioned approximately 80 percent horizontally through the choke and 20 percent vertically through the damaged hydril (as before).

Multiplying this 246,000 lbs/hr flow rate of steam and fluid by the same hydrogen sulfide concentration (440 ppmv) used above in PGV Response AB, PGV estimates that approximately 108 lbs/hr of hydrogen sulfide was emitted to the atmosphere during this period. It should be noted here that the hydrogen sulfide emission rate for an uncontrolled flow event assumed in the PGV ERP Section 8.2.1. was 117 lbs/hr (90,000 lbs/hr of geothermal steam at 1300 ppmv hydrogen sulfide), an emission rate which is almost identical to the hydrogen sulfide emission estimate of 108 lbs/hr for the KS-8 event.

AD. Page 22, paragraph 3, discussion of geothermal flow characteristics and hydrogen sulfide emission rate from start of water injection at approximately 09:30 on 13 June 1991 to shut-in at approximately 10:00 on 14 June 1991.

Water injection down the drilling pipe commenced at approximately 09:30 on June 13, 1991. Pumping was at a rate of approximately 9 to 9.5 barrels per minute, or 378 to 399 gallons per minute (gpm), or 190,000 to 200,000 lbs/hr. The injection of this water had a significant cooling effect on the well bore, but did not succeed in completely "killing" the well. The estimates of total fluid and steam produced at the surface during this period remain at about 246,000 lbs/hr, although a percentage of this fluid produced at the surface was almost certainly the injected water, which would have been essentially free of hydrogen sulfide. Therefore, although the emission rate of hydrogen sulfide during this period of uncontrolled flow may have been as high as the 108 lbs/hr estimated above (see PGV Response AC), the true quantity of hydrogen sulfide emitted may have been substantially less.

AE. Page 23, paragraphs 3 through 6, and page 24, paragraph 1, discussion regarding spot measurements indicating high hydrogen sulfide levels.

PGV concurs that the initial monitoring of off-site ambient hydrogen sulfide concentrations by PGV at 01:00 on June 13, 1991, indicated concentrations of 22 and 29 parts per million (ppm). Once these levels were measured, PGV immediately reported these values to HCD without attempting to gather any more data, since these two readings were relatively high and reinforced the earlier decision to evacuate the residents of Lanipuna Gardens (see PGV Response E to the Element II Report).

However, PGV is aware of no subsequently verified off-site measurements of ambient hydrogen sulfide concentrations taken either through spot checks with the Jerome monitor or measured by the fixed monitoring stations during the uncontrolled flow event that were even close to those two original measurements. In fact, the next closest verified off-site measurement was 40 times less than those two original measurements, and the highest on-site measurements, taken within the steam plume within 25 feet of the well head, were less than this initial high off-site measurement. PGV recently proceeded to investigate the validity of these two readings. Based upon conversations with the PGV staff involved in taking the readings, and communications with the manufacturer of the monitoring instrument, PGV now believes that these two initial ambient hydrogen sulfide concentration readings were in error (see Attachment 1).

During the uncontrolled flow event, all parties acted responsibly in assuming that these initial off-site hydrogen sulfide readings were accurate; to do otherwise during an emergency situation would not be prudent. However, after reviewing the information which became available after the uncontrolled flow event, PGV now believes that the highest measured off-site instantaneous ambient hydrogen sulfide concentration recorded during the uncontrolled flow event was approximately 0.5

parts per million (ppm) [500 parts per billion (ppb)], not the 20 to 29 ppm (20,000 to 29,000 ppb) previously reported. The validity of these initial high off-site values has also not been supported by any of the modeling subsequently conducted as a part of the review of the uncontrolled flow event by the state's review panel (see PGV Response G to the Element III-II Report).

AF. Page 24, paragraph 4, and page 25, paragraph 1, discussion of reported sample of drift emissions.

PGV concurs with the assessment of the Element III-I Report that the analysis of drift reported to have been deposited on a windshield is of little value, both because of the lack of information regarding deposition rate and the legitimate questions regarding the nature of the sampling; the inability to document what materials, including road dust, salt spray, or "laze", may have already been on the windshield; and sample handling procedures. PGV assumes that the statement regarding the possible need for decontamination cleaning of equipment with significant drift deposits is stating the obvious; that is, drift should probably be washed off the surfaces on which it lands. PGV also concurs with the statement that "At the present time it is inappropriate to conclude anything other than the catchment waters met suggested standards on 6/13/91."

AG. Page 25, paragraph 3, discussion of abatement actions to be considered.

It is incorrect to state that PGV had not evaluated or considered implementation of noise abatement techniques or equipment during the uncontrolled flow. See PGV Response AI for additional information.

Most of the systems designed to abate both the noise and hydrogen sulfide should such an event occur in the future have been installed on the drilling rigs, and the remainder are being installed. See Attachment 1 to PGV Responses to the Element I Report for additional information.

AH. Page 25, paragraph 5 and page 26, paragraph 1, required reporting to DOH and quantification of emissions.

ATC permit Conditions 13, 23 and 26 are applicable to this uncontrolled flow event. All three conditions require immediate notification to DOH, followed by a written report within five days. Condition 26, which is specific to uncontrolled flow events, also requires a weekly status report if the uncontrolled flow event continues. All the required reports were submitted to DOH within the required time frames; the Condition 13 and Condition 26 written report was submitted on June 17, 1991; the

Condition 23 written report was submitted on June 14, 1991. PGV does not concur with the implication that emissions other than hydrogen sulfide are required to be reported under Condition 23 of the ATC permit. PGV does agree that no specific data regarding the hydrogen sulfide concentration of the geothermal resource produced from KS-8 is available; for safety reasons sampling was impossible during the uncontrolled flow, and the resource has not been produced to the surface subsequent to shutting in of the wellhead. Thus, the only characterization of the hydrogen sulfide emissions which is possible is from other wells, as both PGV and the Element III Reports have done. PGV also believes that it is not appropriate to extrapolate the concentrations of trace elements reported to be deposited on a car windshield as an indicator that the geothermal fluids from KS-8 are significantly different from those in KS-7.

AI. Page 27, paragraph 4 and page 28, paragraph 1, introduction to event evaluation and recommendations.

The import of the statement that "The accident was not anticipated nor acknowledged until underway" is not clear. It would appear obvious that the uncontrolled flow could not be acknowledged until it occurred. Please see PGV Response I to the Element II Report regarding the planning for such an event in the ERP and the response to the uncontrolled flow event.

No noise or hydrogen sulfide abatement systems were installed on the choke line because discharge of geothermal steam or fluid through the horizontal choke line was not considered under the ATC permit. However, PGV's noise abatement consultant, Tom Norris of Consultants in Engineering Acoustics, was on-site during the uncontrolled flow event, and prepared a noise abatement plan. However, the plan was not immediately implemented because of safety considerations. Specifically, PGV was prepared to install a large diameter pipe and water injection system to "catch" the horizontal steam jet and redirect it upwards.

See also Attachment 1 to the PGV Response to the Element I Report for additional information about the systems which have now been installed, and will be installed, to abate noise and hydrogen sulfide emissions if such an event were to occur again.

AJ. Page 28, paragraphs 2, 3 and 4, and page 29, paragraphs 1 and 2, recommendations for anticipating and responding to future "kicks".

See Attachment 1 to PGV Response to the Element I Report for additional information about the measures implemented or planned to respond to these situations and to control and/or abate any possible future releases. As stated above (see PGV

Response AH), for safety reasons, sampling of the uncontrolled flow was not possible. Given the measures and equipment now in place or proposed to be installed, such sampling should be possible if such an event occurs in the future. PGV believes it is unrealistic to expect that sufficient data will be available during any uncontrolled flow event which could be relied upon to be used in undertaking modeling during the event in order to direct any emergency response. See also PGV Response J to the Element I Report regarding the effectiveness of drilling with air in such an overpressured reservoir.

AK. Page 29, paragraph 5, additional discussion regarding "real-time" mathematical modelling.

See PGV Response AJ.

AL. Page 30, paragraph 4, discussion regarding emissions estimates.

PGV agrees that emissions estimates may have helped the emergency response personnel during the uncontrolled flow event but, as discussed in PGV Response AH, sampling of the KS-8 well was not possible during the uncontrolled flow event for safety reasons. Thus, the only estimates of hydrogen sulfide emissions available during the uncontrolled flow event were those used in the Element III-I Report, i.e., visual estimates of the amount of geothermal fluid being emitted; an assumption of the hydrogen sulfide concentration for adjacent wells; and an addition of a safety factor.

AM. Page 30, paragraph 4 and page 31, paragraph 1, discussion of different ambient concentration "goals" in the permit.

PGV does not agree that the ATC permit "is confused by differing ambient goals under different operational or breakdown scenarios." In the PGV ATC, DOH limited ambient hydrogen sulfide increases for three different states of the PGV project to the lowest feasible levels for each specific state, such that "normal" operation of the geothermal wellfield and power plant may only increase ambient hydrogen sulfide concentrations by 5 ppb above background. PGV accepted these very restrictive limitations on the allowable increases in ambient hydrogen sulfide concentrations only because these ambient hydrogen sulfide levels were to be measured above background levels. At no time did DOH set or define specific "ambient goals", as the Element III-I Report seems to state. See PGV Response S.

PGV notes that the discussion here, and essentially all the remaining discussion under Chapter 7.0 of the Element III-I Report, is unrelated to the KS-8 well uncontrolled flow event and its aftermath.

AN. Page 31, paragraph 6, and page 32, paragraph 1, discussion of ATC permit Condition 20 regarding resource testing.

PGV does not believe that resource testing can be effectively undertaken during any period when no separator is used (such as initial cleanout) as the fluid flow is in two phases. In The Geysers, this is no problem, since the geothermal resource flow is only a single (steam) phase. However, PGV believes that the relative and absolute concentrations of the components in the geothermal fluid which could be released into the air are also of less concern in Puna than in The Geysers since normal operations for the PGV project will not result in the release of any trace elements contained in the geothermal fluid to the atmosphere. In The Geysers, approximately 80 percent of the produced geothermal fluid is not returned to the reservoir and, thus, a significant amount of the produced trace elements enter the environment in The Geysers.

AO. Page 32, paragraph 3, discussion of ambient limit.

See PGV Response S.

AP. Page 34, paragraph 2, definition of "normal" operations.

PGV interprets ATC permit Condition 17 to exclude "stacking" (use of the emergency steam release facility) from the definition of "normal" power plant operations. Accordingly, the statement expressed in the Element III-I Report, that venting may occur simply to prevent the condition limiting increases in ambient hydrogen sulfide concentrations to 5 ppb from being enforced, is unfounded.

AQ. Page 34, paragraph 4, discussion of monitoring of drift concentrations.

PGV does not disagree with the desirability of characterizing the components of drift emissions. However, given the substantial differences between the operation of geothermal projects which have continuous drift emissions (e.g., those projects operating in The Geysers) and the PGV project (which will produce no emissions during normal operations), PGV does not believe that the expense and effort required for ambient monitoring of components of the drift are justified.

AR. Page 34, paragraph 5, discussion regarding gas injection.

PGV, through a contract with the University of Hawaii, has completed a pilot-scale test of the PGV brine, condensate and noncondensible gas injection system. This test successfully demonstrated the feasibility of the injection system by using actual geothermal fluid from the reservoir.

AS. Pages 35 and 36, Air Conclusions 1.

PGV does not agree that the plume release characteristics and quantity of hydrogen sulfide released were more severe than assumed plausible in the existing worst case uncontrolled flow event scenario in the PGV ERP. In fact, the actual hydrogen sulfide emission rate was almost identical to that predicted in the PGV ERP,and the ambient air concentrations predicted in the PGV ERP conformed remarkably well with the actual measurements from the monitoring stations when the plume was being measured. See PGV Response AC.

AT. Page 36, Air Conclusions 2.

PGV believes that this conclusion is not correct. Please see PGV Response AE.

AU. Page 36, Air Conclusions 3.

Please see PGV Response AE.

AV. Page 36, Air Conclusions 7.

Please see PGV Response AH.

AW. Page 36, Air Conclusions 8.

Please see PGV Response AI.

AX. Page 37, Air Conclusions 14.

PGV believes that it is inappropriate to imply that the 100 ppbv one hour average level allowed in the ATC for very specific, limited events (vertical venting and pipeline cleanout) is the level to which the community will be exposed on a regular basis. In fact, PGV is required to notify residents located near to the project site for the permitted events subject to this level limitation, and to limit all other operations to levels of either 5 ppbv one hour average or 25 ppbv one hour average over background. Given a current background level of zero, both 5 ppbv one hour average or 25 ppbv one hour average are <u>more</u> stringent than the California state standard of 0.03 ppmv (30 ppbv) one hour average for hydrogen sulfide.

AY. Page 37, Air Conclusions 15.

PGV believes that this conclusion is inappropriate because no support is offered for the Element III-I Report's presumption of "a high exposure occurring and going unmeasured" or a "massive and sudden release". Given all of the evidence available to date, PGV believes that at no time during the uncontrolled flow event were any of the nearby residents subjected to any substantial endangerment to human health. As stated on page 5 of Chapter 5 of the PGV ERP, "PGV anticipates no project-created situation which would not provide sufficient time for the CDA (HCD) to warn or evacuate the public, as appropriate." Based on all the evidence now available regarding the uncontrolled flow event from the KS-8 well, PGV sees no reason to revise this statement.

AZ. Page 37, Air Conclusions 19.

Construction and use of well cellars is standard practice in the geothermal industry for wells that employ expansion spools in the well completions, and expansion spools are used in all PGV well completions at this time. Cellars are used so that the well master control valve can be operated from the ground, and to reduce horizontal stress on the wellhead assembly by keeping the wellhead piping as low to the ground as possible. Both of these steps are taken to increase worker and equipment safety during operation of the wellfield.

All geothermal well cellars will be covered with a heavy metal grating and fenced to prevent unauthorized entry after the completion of drilling. Standard industry safety practices are, and will continue to be, observed regarding worker entry to the cellars, which are classified by PGV as restricted entry areas. For example, workers do not enter any cellar without first checking for the presence of hydrogen sulfide, and do not enter the cellar without using the "buddy" system, so no one works in any cellar unobserved and unsupported.

BA. Page 38, Conclusions Noise 2, regarding noise monitoring equipment.
See PGV Response V.

BB. Page 38, Conclusions Noise 3, regarding GRP permit requirements.

PGV cannot agree with the statement made in the Element III-I Report, that the noise levels permitted in the GRP "are known to interfere with sleep and daytime levels can interfere with speech," since the noise levels typically permitted in the Geysers geothermal areas (an L_{dn} of 55 to 50 dBA in the most sensitive areas) actually permit

even higher noise levels than are allowed under the PGV GRP (55 dBA during the day and 45 dBA at night). Please see PGV Response W for additional information.

BC. Page 38, Conclusions Noise 5, regarding GRP permit requirements not being measured.

PGV does not agree that the GRP noise conditions require the measurement of L_{10}'s. Please see PGV Response W.

BD. Page 38, Conclusions Noise 8, regarding direct drive rigs as BACT and noise controls interfering with safety.

Please see PGV Response J.